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THE GEOGRAPHICAL REVIEW

VOL. IV

OCTOBER, 1917

No. 4

RECENT EXPLORATIONS ON THE CANADIAN ARCTIC COAST*

By RUDOLPH MARTIN ANDERSON

Chief of the Southern Party, Canadian Arctic Expedition, 1913-1916

The Canadian Arctic Expedition consisted of two main divisions, the Northern Party, commanded by Vilhjalmur Stefansson, and the Southern Party, under my direction. The Northern Party was to devote its chief attention to the Beaufort Sea in the region west of the Parry Archipelago and north of Alaska and Yukon Territory. The Southern Party planned to explore the northern coast of Canada between Cape Parry (124° W.) and Kent Peninsula (108° W.). It was arranged to have its surveys extend inland about 100 miles and also cover the southern and eastern portions of Victoria Island. The scope and variety of the scientific work called for a staff of specialists, and we were fortunate in securing trained and experienced men whose devotion to the arduous and prolonged field work is a token of the value of their results.¹

We cleared from Nome in the gasoline schooner *Alaska*, July 19, 1913, reaching Point Barrow on August 19, after some difficulty with gales in Bering Sea and Kotzebue Sound. The gasoline schooner *Mary Sachs*, an

* Published by permission of the Deputy Minister, Department of Mines, Ottawa, Canada.

¹ The Southern Party included one geologist, Dr. J. J. O'Neill of the Canadian Geological Survey; two topographers, Mr. Kenneth G. Chipman and Mr. John R. Cox of the Topographic Division of the Geological Survey; two anthropologists or ethnologists, Mr. D. Jenness of New Zealand, an Oxford man with field experience in New Guinea and elsewhere, and M. Henri Beuchat of Paris, who had gained distinction by writings on American archeology; a meteorologist and magnetician, Mr. William Laird McKinlay of Glasgow University; a marine biologist who also studied the plants and insects, Mr. F. Johansen, recently of the Department of Agriculture at Washington, and a former member of the Danish East Greenland Expedition, under the late Mylius Erichsen; a photographer and cinematographer, Mr. George H. Wilkins of Adelaide, Australia; and the leader, who, as a zoölogist of the Geological Survey, was to study birds and mammals and collect specimens for the Victoria Memorial Museum at Ottawa.

Owing to the complications which arose over our not connecting with the *Kartuk* at Herschel Island, one of the anthropologists, Mr. Beuchat, and the meteorologist, Mr. McKinlay, were not able to join the Southern Party, and the cinematographer, Mr. Wilkins, was able to be with us for only a small part of the time. Mr. Jenness was able to cover most of the proposed field, however, and, by division of labor, complete meteorological observations were obtained. The magnetic instruments were lost on the *Kartuk*, and that branch of science was not represented in the final results.

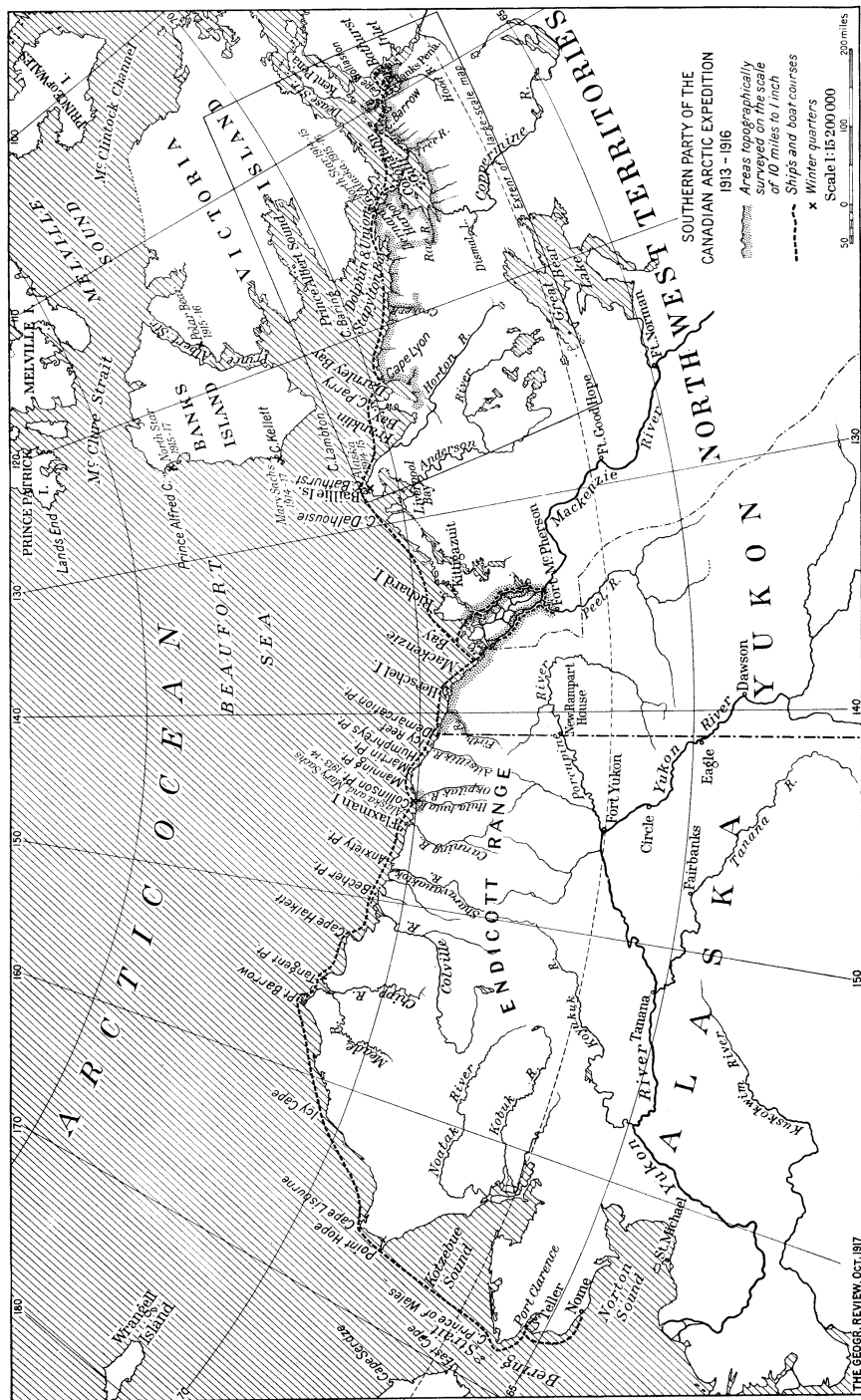
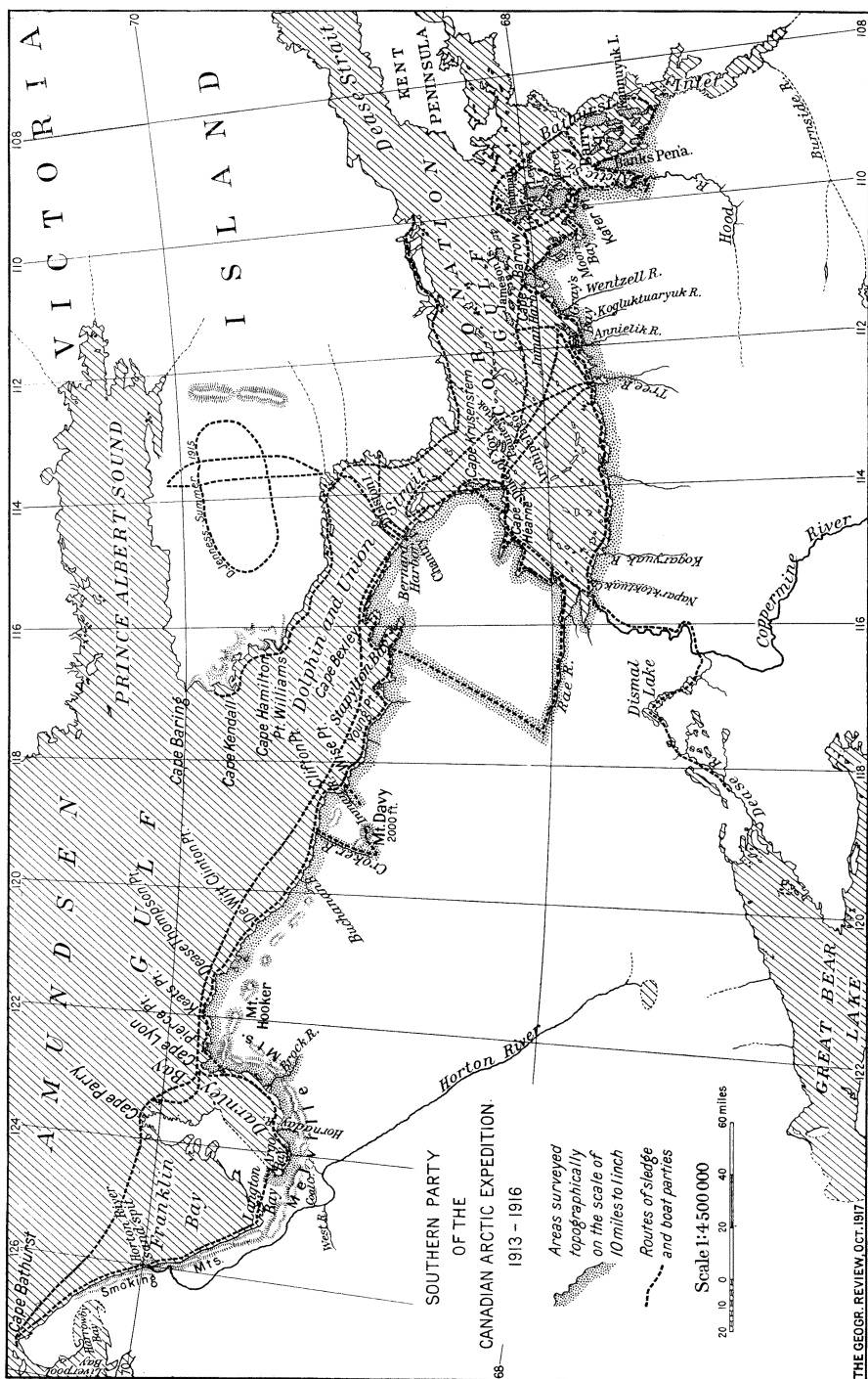


FIG. 1.—General map of the Arctic coast of Alaska and northwestern Canada showing the field of activity of the Southern Party of the Canadian Arctic Expedition of 1913-16. Scale, 1:15,200,000. The rectangle on the right indicates the extent of the detailed map, Figure 2.



auxiliary freighter for the expedition, sailed about the same time. Like most vessels starting out for a long Arctic sojourn we were overloaded. In addition to our scientific equipment we had provisions for three years and various supplies, which included almost everything from a needle to an anchor. The decks were encumbered with lumber, sledges, dogs, dredges, and all the miscellaneous gear that was dumped on top because there was nowhere else to put it.

East of Point Barrow we found the Arctic Ocean practically filled with heavy ice. In that part of the world there are no true icebergs; but enormous pressure ridges often form along tide-cracks or are heaped up by gales along the edge of the floe fields, where they are cemented by spray and by spring thaws and augmented by snowdrifts. These masses are sometimes of immense size, rising thirty or forty feet out of the water—too large to melt during the short summer. The ice conditions east of Point Barrow seem to depend largely upon the prevailing winds during the early summer. If the winds are easterly the ice masses move out to the north-westward of Point Barrow and Wrangell Island, leaving an open ocean for navigation. If the winds are westerly the great ice-pack is jammed against the northern coast of Alaska and the region about the mouth of the Mackenzie, where there is no easterly exit.

In 1913, for the first time in about twenty-five years of whaling in that region, no ship from the west was able to reach Herschel Island. It was known as "a bad ice year." Of the ships caught in the ice two were sunk. As usual when the sea is filled with great masses of ice, the temperature of the water and the air was much lower than normal, snow squalls were frequent, young ice kept forming in the spaces between the larger ice cakes, and the solid freeze-up occurred a month earlier than normally. The occasional large masses scattered among the crushed-up areas of bay ice are an advantage to vessels of small draught. The large ice cakes ground on the gradually shoaling bottom some distance off shore, and small vessels can get shelter by tying up behind them. The ice would occasionally relax its grip on the coast and move off half a mile or so with changes of tide or wind, and the vessels could creep ahead a little. The *Alaska* and *Mary Sachs* were finally obliged to give up hope of getting farther than Collinson Point, Alaska, 69° 59' N. and 144° 50' W., and decided to go into winter quarters September 10.

At Collinson Point luckily we fell heir to a large, recently abandoned log cabin, well built of driftwood logs, and driftwood fuel was abundant, as it is in most places on the coast for two or three hundred miles on either side of the Mackenzie River delta. Game was scarce, as the caribou have been nearly exterminated on the Arctic coast of Alaska, but some mountain sheep and a small amount of caribou meat were brought down by inland Eskimos.

The men of our party rapidly became used to outdoor life and travel in

the Arctic and the technique of making scientific observations at low temperatures. A snow house makes a good observatory, although at 40° below zero a light breath or even the invisible vapor from a bare, warm hand will speedily cause a film of fog or frost to form on lenses and all metal parts. Even guns are kept outside all winter, for if taken indoors they instantly become coated with heavy white frost and drip water as the metal becomes warm, causing rust inside and out if they are not taken apart and cleaned soon after.

In February O'Neill and Cox started for the international boundary (141st meridian), about 100 miles east of our winter quarters, to complete the survey from the boundary to the Mackenzie River, connecting with the survey made by the International Boundary Survey party in 1912. This spring's work and that of the next two seasons demonstrated that very little accurate topographical surveying on the lines laid down for us (ten miles to the inch, with control stations at frequent intervals) could be done before the middle of March. Some compass lines could be run before that time, where salient points were already located, but earlier in the season the sun is too near the horizon to get satisfactory observations, on account of the refraction. Blizzards and clouded skies are so frequent that calculated occultations of stars and planetary satellites rarely can be observed at a stationary observatory and are of little use in field work.

In addition to the coast survey from the international boundary, there was carried out a geological traverse up the Firth River (Herschel Island River) into the Endicott Range and a geological reconnaissance of Herschel Island.²

As soon as the Mackenzie River ice broke up, Chipman surveyed the east branch in company with O'Neill, and Cox surveyed the west branch. This survey shows the west branch to have a channel at least six feet deep through the shoals at the entrance into the deep water of the river. The east branch has a channel with about the same depth of water. The middle branch, which is supposed to be the deepest, was not surveyed because the boat parties had to join the *Alaska* at Herschel Island and go east to their main field of work. The Mackenzie furnishes an immense waterway, for boats drawing not more than six feet, southward as far as Great Slave Lake, where shoals at a depth of about five feet form a barrier at low-water stages. Otherwise there is deep water from the coast up stream as far as Fort Smith, on the 60th parallel.³

Herschel Island, Y. T., 69° 34' N., 138° 54' W., is quite a busy place in July and August. Eskimo whaleboats to the number of twenty-five or more and perhaps a dozen two-masted Mackenzie-built schooners are usually assembled here to trade with incoming ships; and in 1915, the Hudson's Bay Company established a Western Arctic district with headquarters at

² *Summary Rept. Geol. Survey of Canada for 1915*, Dept. of Mines, Ottawa, 1916, pp. 236-237.

³ *Ibid.*, pp. 237-239.

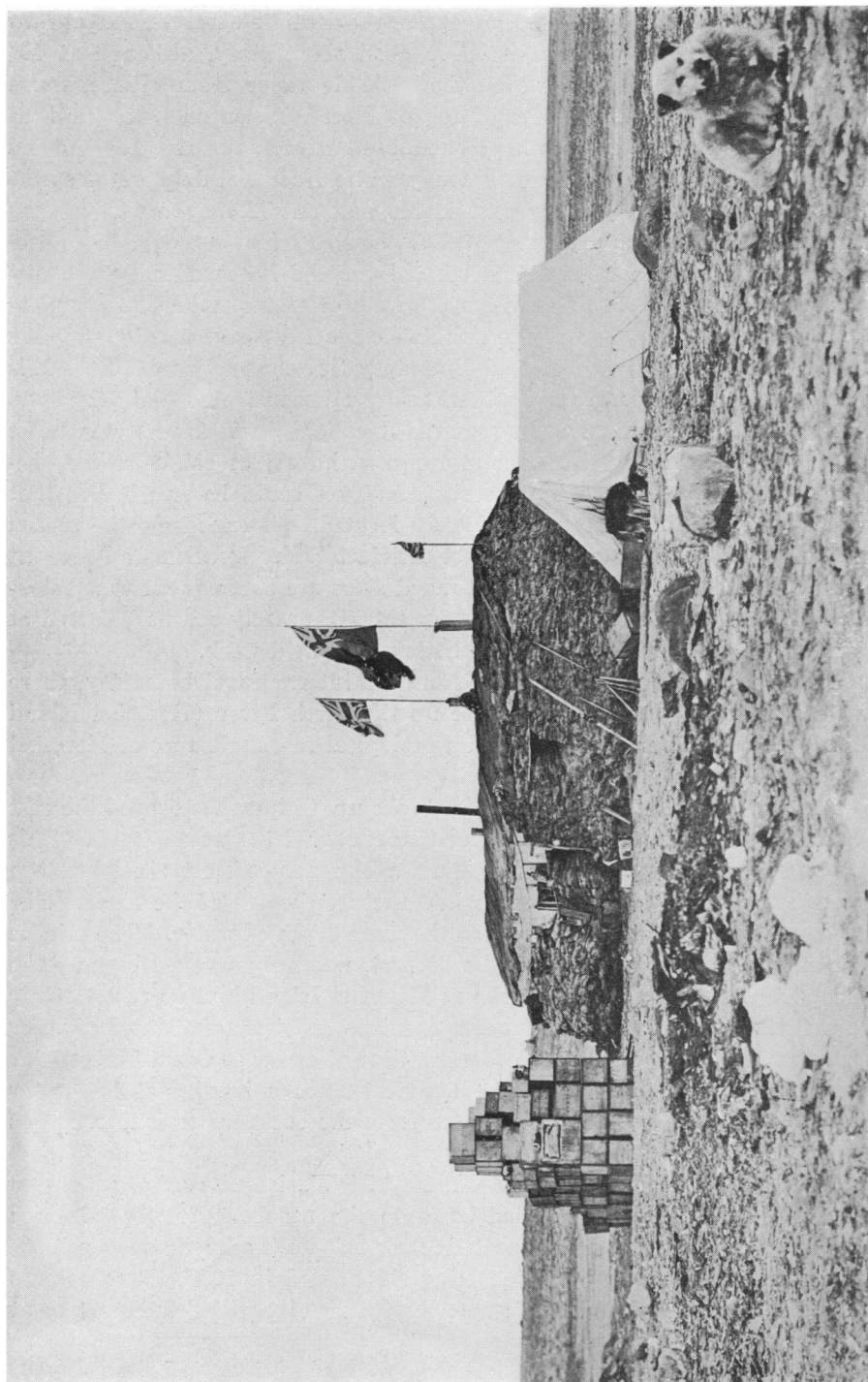


FIG. 8.—House used by Southern Party of Canadian Arctic Expedition as base from 1914 to 1916.



FIG. 4—Camp near northern limit of trees on east side of Coppermine River, near Sandstone Rapid. Trees here are thick at their bases, but rapidly taper off. Note large number of dead trees, mostly killed by bark-beetles. February 15, 1915.

Herschel Island. Other posts were founded 150 miles east of the Mackenzie at Baillie Island or Cape Bathurst, $70^{\circ} 35' \text{N.}$, $128^{\circ} 5' \text{W.}$, and at Kit-tigazuit (the old Point Encounter of Sir John Richardson) at the eastern edge of the Mackenzie delta, the site of one of the largest villages of the Mackenzie Eskimos. In 1916, the company moved 400 miles farther east and established a new post at the station just vacated by the Southern Party in Dolphin and Union Strait (Bernard Harbor). These new posts of the "Big Company" are supplied by a gasoline motor schooner, the *Fort McPherson*, from the large storehouses at Herschel Island stocked by chartered ships sent up from Vancouver.

The importance of the animal life of the northland of Canada has been recognized for hundreds of years, so much so that all the northern regions were long known as the "Fur Countries." Of the total amount of fur produced, the Arctic realm itself has not furnished so much as the wooded country farther south, partly because of its greater barrenness and inhospitality, which results in fewer valuable species than the timbered country produces, partly because of fewer natives, and partly because of its inaccessibility. In recent years, however, owing no doubt to greater competition among fur traders outside, the advance of trade into the north has been rapid, both by the large companies and by small independent vessels, free traders, and trappers.

In traveling over the Arctic lands, we find few regions so inaccessible or desolate that they can not support at least some natives who have been schooled by necessity to make use of meager resources. When the country is ultimately opened up, to a much greater degree than at present, and developed for its timber resources in the more southerly portions and possibly for mineral wealth farther north, the game of the country may by proper conservation become a valuable asset and the fur industry still remain of importance in vast regions which may have no other use.

The *Alaska* left her first winter quarters at Collinson Point on July 25, 1914, the first day the ice moved off shore, and, after some blocking by ice, reached Herschel Island on August 5. The *Mary Sachs* arrived a little later. These expedition vessels were the first ships to come into Canadian waters in the western Arctic flying the Canadian flag. Stefansson had started from Martin Point, Alaska, in March on an ice exploring trip. His support party had returned in April, but Stefansson and his two seamen, Storker Storkerson and Ole Andreason, had not returned. If they had returned to the mainland in the spring they would have been heard from sooner, and our knowledge of their proposed plans made it evident that they had gone on towards Banks Island. The *Mary Sachs*, with a full equipment for two years and under the command of George H. Wilkins, sailed for Banks Island August 11, and found Stefansson's party near Cape Kellett early in September.

On August 17 the *Alaska* left Herschel Island eastward bound, was

delayed by ice between the island and Shingle Point (on the west side of the Mackenzie delta), and reached Baillie Island (Cape Bathurst) on August 21. Sailing through smooth summer seas that were free of ice, we reached our goal at Bernard Harbor, Dolphin and Union Strait, $68^{\circ} 47' \text{ N.}$, $114^{\circ} 50' \text{ W.}$, in the evening of August 24. After the stores had been unloaded and the members of the scientific staff had disembarked, the *Alaska* returned to Herschel Island but was prevented by bad weather and ice conditions from returning farther east than Cape Bathurst in 1914.

As soon as the ice was good for travel I set out on the 400-mile trip along the coast from Cape Bathurst to join the rest of the party at Bernard Harbor. At Keats Point we met O'Neill and Chipman, who were making a preliminary reconnaissance trip along the coast, and we reached the base station together on Christmas Day, 1914. They had found the fogs and blizzards of autumn very unsatisfactory for survey work, though the temperature was scarcely ever below zero Fahrenheit even during December. When we met them they had been held in camp for six days, with strong head winds and blizzard, while we had been able to travel part of the time with fair wind, which makes a tremendous difference.

DETAILED SURVEY WORK

O'Neill and Chipman made a detailed survey of this coast in March, April, and May, 1915, filling in the blank unexplored section of Darnley Bay between Cape Parry and Cape Lyon, fixing the position of Hornaday River⁴ flowing into the south side of Darnley Bay, and going some distance up the river flowing into the southeast side of the bay. For the convenience of future travelers, we have adhered to the policy of retaining the native place names wherever these could be ascertained, but as this particular stretch of coast is uninhabited, we have proposed the name "Brock River" for the southeastern river, in honor of Major R. W. Brock of the Canadian Expeditionary Forces, recently Director of the Geological Survey, to whose active interest in northern geology the organization of the geological and topographical sections of the expedition was largely due. After a long trip up the Coppermine to the Dease River, I went west along the coast in the spring to reinforce the western survey party. At the same time Cox mapped the west end of Coronation Gulf, ascended the little-known Rae River about seventy miles to the junction of two small creeks which unite to form it, and then made an overland portage to Stapyhton Bay, cutting through the middle of another large unexplored district. Large willows were found at frequent intervals on the Rae River after he had penetrated some miles from the coast, but no spruce or other timber was found. The rock exposures were the prevailing dolomite of the region, with diabase near the mouth of the river. Caribou were seen migrating northward nearly every day during the early part of May, in the Rae River region.

⁴ A. J. Stone: Some Results of a Natural History Journey, etc., *Bull. Amer. Mus. Nat. Hist.*, Vol. 13, 1900, pp. 31-62.

The country west of Coronation Gulf is mostly drift-covered, with occasional exposures of dolomite in sea cliffs and in the river valleys. There is a little conglomerate near Buchanan River, and a few dikes of diabase occur in the Darnley Bay region and for some distance east of Cape Lyon. These dolomite cliffs are also typical of southwestern Victoria Island. At Point Williams and Cape Hamilton are vertical dolomite cliffs about 125 feet high, where hundreds of gulls nest in niches in their face. Rock fossils are extremely rare, but several species of Silurian corals were found on Liston Island in Dolphin and Union Strait. Large numbers of king eiders and Pacific eiders nest on small islands on both sides of Dolphin and Union Strait, but this particular district seems to be too dry and too barren to support any kind of shore birds or land birds in large numbers.⁵

The western survey having been finished late in May, O'Neill and Cox started eastward from Bernard Harbor on June 9. The expedition had always prided itself on being thoroughly prepared and equipped to take the field and work at any season and under any conditions. These problems of equipment embraced winter and early spring sledging with tent and snow house, using either wood alcohol, Primus oil stove, or native blubber lamp; late spring travel on either ice or water; summer travel with boat or canoe; and overland packing by men and dogs in summer.

In Coronation Gulf the ice was still solid in June, but there was the possibility of cracks and leads to cross later, and boat work after the break-up. The Northern Party had made good use of waterproof tarpaulins in constructing sled rafts to cross leads, being unable to haul canoes over the rough ice. This made no provision for travel after the break-up of the ice.

We made very satisfactory provision for this kind of travel by strengthening the stern timbers of a large Point Barrow whaling umiak, 28 feet long and covered with heavy bearded-seal skins, providing for the attachment of an Evinrude motor and carrying the umiak on a low ivory-shod boat sled. In the spring, a few dogs could haul this boat with ease, carrying several hundred pounds of baggage inside, and it could be unshipped and launched in a few minutes whenever a ferry was needed. In fact, if the ice should break, the canoe would be loaded and launched automatically. Later in the season the umiak with from two to four men, three dogs, and a thousand pounds or more of guns, gear, grub, and gasoline, made from five to six miles per hour, weathering some pretty stiff seas. It could be beached on any kind of coast in a hurry, by rolling it up on inflated sealskin "pokes," a great advantage when exploring a coast whose harbors are unknown and a sudden breeze raises a dangerous lop in a very short time. The umiak is very useful among ice-floes, as it is practically impossible for it to be stove; it can easily be hauled up on an ice cake, and it will also stand bumping

⁵ *Summary Rept. Geol. Survey of Canada for 1915, Ottawa, 1916, pp. 220-239.*

over the boulders on a river bottom which might prove disastrous to a wooden boat.

The canoe party crossed Coronation Gulf direct from Cape Krusenstern to the mouth of Tree River, $67^{\circ} 46' \text{ N.}$, $111^{\circ} 59' \text{ W.}$, being delayed by but one large crack. This route leads past numerous islands, including the Duke of York Archipelago. These islands, of which the Pauneraktok group are typical, have in most cases precipitous cliffs of diabase, frequently overlying sandstones, facing the south or southeast and sloping down on the north and west sides. Part of June and all of July were spent around Port Epworth or Tree River (Kogluktualuk of the Eskimos). A little west of Tree River granite rocks begin to appear. On the south side of Coronation Gulf the granite is overlain in places with shale, limestone, or sandstone; on Gray's Bay by schist; on Bathurst Inlet by dolomite and quartzite; and throughout the whole area frequently cut by dikes and capped over large areas by sills or flows of basalt or diabase.

Tree River was explored on a packing expedition some distance inland. It is said to have one of its heads near the Coppermine, and to have spruce trees on one branch. Like all the other streams of this region (in the granite area) it has rapids, cascades, and falls a few miles from its mouth, and is full of fish in the summer time. Several families of Eskimos usually spend the summer at the first cascade, catching fish by spear and hook, and by raking with a sort of double gaff-hook. Salmon trout and whitefish are largely caught in the rivers, while large lake trout are caught in nearly every lake of any size.⁶

Chipman and I brought a small gasoline launch to Cape Barrow ($68^{\circ} 1' \text{ N.}$, $110^{\circ} 59' \text{ W.}$) on the schooner *North Star* on August 12, met the canoe party, and operated with them for the remainder of the season, surveying Moore Bay, Arctic Sound, Hood River, Barry Island, and other parts of Bathurst Inlet. Parts of this region had not been visited since Franklin in 1821, or Dease and Simpson in 1837 and 1838, and, as these explorers had only made a hurried trip with canoes and cut across many points without careful examination, we made many interesting discoveries in the intricate system of deep, narrow fiords and numerous islands in Bathurst Inlet.

Cape Barrow, or Haninneq, as it is called by the Eskimos, is a mountainous granitic region, but is not nearly so high as stated by Franklin in 1821. He says: "The higher parts attain an elevation of 1,400 and 1,500 feet and the whole is entirely destitute of vegetation."⁷ In 1915 we found the height of the highest of the granite ridges to be 340 feet above sea level by aneroid, and although the hills have a barren appearance on their summits and slopes, careful inspection shows many bright green patches in the little valleys and gullies, where soil has collected, as well as in basins in the rocks,

⁶ *Summary Rept. Geol. Survey of Canada for 1915*, Ottawa, 1916, pp. 240-241.

⁷ John Franklin: *Narrative of a Journey to the Shores of the Polar Sea*, London, 1823, p. 369; also as reprint in "Everyman's Library," p. 375.



FIG. 5.



FIG. 6.



FIG. 7.

FIG. 5—Start of survey party from Bernard Harbor, Dolphin and Union Strait, with skin umiak on boat-sled, June 9, 1915. The umiak is "bowsed up" across top to prevent breaking keel on sled. Evinrude motor, gasoline, and excess baggage carried inside canoe hauled easily by five dogs.

FIG. 6—C. G. S. *North Star* leaving the small deep harbor at Cape Barrow, Coronation Gulf. Harbor surrounded by granite rocks. Jameson Islands visible to the northward, in the background. August 12, 1915.

FIG. 7—Rock cairn, forming cross 12 feet high, erected by Dease and Simpson in 1839, on point between Port Epworth and Gray's Bay. Left to right: J. R. Cox, J. J. O'Neill, K. G. Chipman. September 30, 1915.



FIG. 8.



FIG. 9.

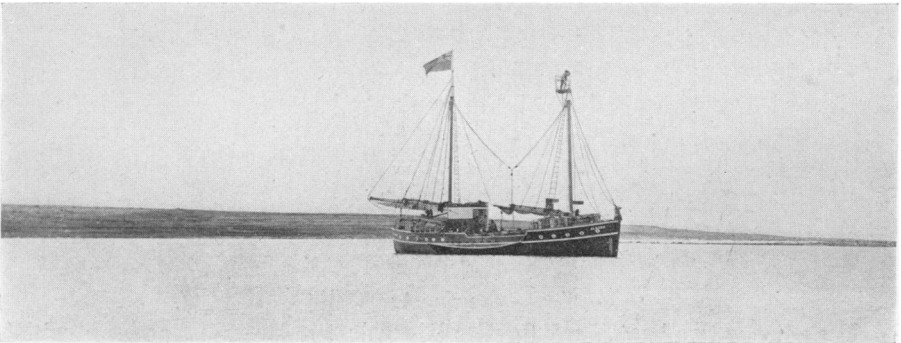


FIG. 10.

FIG. 8—Eskimo village of snow houses and caribou-skin tents on island near mouth of Coppermine River, Coronation Gulf, October 27, 1915. The Eskimos here have recently arrived from their annual autumn caribou hunt inland and are preparing to go out on the ice sealing later.

FIG. 9—Eskimos coming down the Kogluktualuk (Tree) River from the first rapids, where they have spent the summer fishing. This man has an extemporized sled made by lashing together green willow saplings to form a frame and building up the runners of mud and tundra muck frozen on and coated with ice.

FIG. 10—C. G. S. *Alaska*, loaded and ready to sail out, in Bernard Harbor, July 12, 1916.

around the little lakes—green grass, low dwarf willow, deep tundra moss, cotton-grass or “nigger-head” tussocks, heather growing luxuriantly on many shelving rocks, and about ten species of flowering plants in bloom close to our camp on August 13, 1915. The summits of the granite ridges in general were covered with gray lichens. In this region we were often deceived by great reddish areas on cliffs, which had the appearance of ferruginous rock, but upon closer examination proved to be only a dense coat of red lichens.

A considerable copper-bearing area was found in Bathurst Inlet and was followed up, with a view to making a detailed geological sheet of an important area rather than attempting to make a complete survey of the head of Bathurst Inlet outside the copper area. The scenery in Bathurst Inlet is most striking, cliffs of dolomite overlain by diabase rising to a height of 870 feet in the Banks Peninsula region, at Cape Wollaston, the north end of Banks Peninsula, 67° 38' N., 108° 40' W., and to over 600 feet on Barry Island. Caribou were seen at Kater Point, near Hood River, and on Kannuyuk Island, and were taken without difficulty when we needed meat. A large Barren Ground bear was killed on Arctic Sound. Two wolverines were shot and others seen, the species being surprisingly common far north of the timber line in this region.

Among the points of interest noted on the south side of Coronation Gulf west of Cape Barrow was the great length of Inman Harbor, a very deep, narrow fiord, the head of which is separated by a low portage of half a mile from another deep inlet running in from the east side of Cape Barrow, nearly making an island of the Cape Barrow peninsula. West of Cape Barrow there are three fairly large rivers flowing into Gray's Bay. The eastern is called Utkusikaluk (charted at its mouth by Sir John Franklin in 1821 and by him named the Wentzell River), the middle and apparently the largest river is called Kogluktuaryuk, and the western, Annielik (incorrectly indicated on Hanbury's map⁸ as the Unialik). Tree River, or Kogluktualuk, flows into a fine large bay called Port Epworth, about 65 miles east of the Coppermine; about 25 miles west of Tree River is the big Kogaryuak, and about 18 miles from the Coppermine River is a smaller stream also called Kogaryuak by the natives. All of these rivers have falls or rapids a very few miles from the coast.

We got our two boats back to Tree River just before the freeze-up, which occurred on October 5. Sleds had been cached there, and the surplus dogs had been left at the fishing-place for the summer with some local Eskimos. Dried fish had been cached here in the summer, fat caribou meat was obtained in the fall, and, by frequently dropping a net for fish, shooting caribou, Arctic hares, and other game when needed during the summer, we had been enabled to keep a large stock of reserve provisions and had no hardship in waiting at Tree River for about three weeks, until the ice of

⁸ D. T. Hanbury: *Sport and Travel in the Northland of Canada*, London, 1904.

Coronation Gulf became strong enough for us to start for home on October 27 without following all the indentations of the coast. We reached Bernard Harbor station with our sleds November 9, 1915, and received the first news of the loss of our friends on the *Karluk* and of the European War, when it had been raging for over fifteen months.

MIGRATION OF THE CARIBOU

An interesting and important feature of the Coronation Gulf region is the migration of the Barren Ground caribou from the mainland northward to Victoria Island in April and May, and a southward migration as soon as the ice is strong enough for crossing again in November. The exact crossing place of the larger herds seems to vary from year to year. Thus, in 1914, the straits froze over very late and the caribou from the north bunched up on the south shore of Victoria Island. Being unable to cross they slowly drifted eastward along the coast and crossed Coronation Gulf mainly east of Cape Krusenstern. In 1915 they crossed in large numbers at Bernard Harbor around the middle of November, and in a few days we stowed away forty-five prime carcasses for our winter meat supply. Cold storage is simple. By merely keeping it under cover, meat remains frozen until June. Very few caribou are found around Dolphin and Union Strait coast in winter, although a few stragglers have been seen. In three different years I have found them in fair numbers near the coast around the mouth of the Coppermine River.

ARCTIC TIMBER AREAS

The northern limit of spruce trees on the Coppermine River is about 20 miles from the coast, although some stragglers are found growing five to ten miles from the coast on Naparktokuok Creek, a few miles east of the river. Willows of good size, and from ten to fifteen feet high, are found in many places north of the tree line, and persist until they dwindle to small ground-creeping shrubs on the northern islands and wind-swept mainland coast.

To the west there are no trees anywhere near the coast until we come to Franklin Bay, where we find spruce of fair size ten or fifteen miles inland in the valley of Horton River. Spruce comes rather close to the coast on the Anderson River south of Liverpool Bay. Still farther west we find the great northward extension of timber in the Mackenzie delta, fair-sized trees occurring northward nearly to Richard Island about 150 miles north of the Arctic Circle.

On the Horton River, the Coppermine River, around Dismal Lake, and to a less extent farther west, we often noted the large proportion (in some places 90 per cent) of dead spruce trees near the northern limit of timber. There seemed little evidence of fire destruction, and the explanation that the northern regions are becoming colder and the vegetation retreating

seemed inconclusive. On one of our winter trips Mr. Johansen accompanied a sledge party southward to the timber line on the Coppermine River and made a careful study of conditions. He found that practically all the dead trees showed traces of the ravages of bark beetles, three species of them being found.

SURVEY OF THE UNEXPLORED CROKER RIVER

After returning from the Coppermine River trip, Mr. Chipman and myself made a survey for some distance up the Croker River, the largest river flowing into Amundsen Gulf, between Darnley Bay and Coronation Gulf. The mouth of the river is indicated on Franklin's and Richardson's maps, about fifteen miles west of Clifton Point ($69^{\circ} 13' N.$, $118^{\circ} 40' W.$), and Richardson mentions the size of its delta. The river itself was of particular interest to us because it promised to give an important geological section into the heart of the Barren Grounds halfway between O'Neill's reconnaissance in from Darnley Bay and Cox's traverse from Rae River to Stapyhton Bay, the whole intervening country inland having been hitherto a *terra incognita*.

The apparent size of the river at the coast, where it spreads out into a triangular delta about five miles on each side, is larger than the actual volume of the river bears out, for, before emerging from its dolomite box-canyon about five miles from the coast, the river averages only about sixty yards in width. It probably carries considerable water for a short time, as the snow melts very rapidly on the Barren Grounds in spring and the ice breaks up early.

The deep and strikingly picturesque canyon of Croker River was unsuspected, as the surrounding country is rather gently rolling and one could come within a mile of the gorge without seeing any sign of it. We found that the river had cut a vertical-walled canyon through yellow dolomite rock for over twenty miles, averaging three hundred feet in depth for most of the distance, with no way out of the gorge at the sides for miles. Remarkable pillars and castellated rock effects were frequent.

Heavy snowdrifts (due to the prevailing winds) overhung the west bank of the river in immense cornices in many places, and there had been great avalanches here and there that made barrier ridges of hard, icelike, angular-fractured snow blocks extending most of the way, and sometimes all the way, across the river. The river continually makes short, sharp bends, but its general course is northerly. It finally became so obstructed by avalanche barricades that we could scarcely take a loaded sled over them and were obliged to cache most of our load. Farther up the river seemed to have quite a steep descent, with some rapids, if not waterfalls. The snowdrifts and ice barriers were so deep, however, in most places that it was impossible to see the character of the river bed. In some stretches of the river progress was only made by climbing over one rugged hill of fallen



FIG. 11.



FIG. 12.

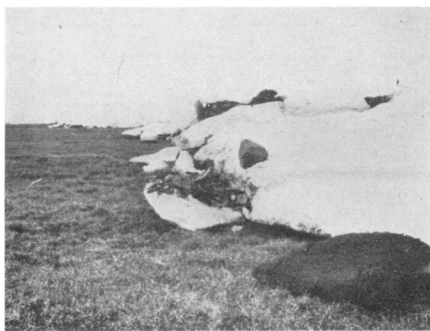


FIG. 13.

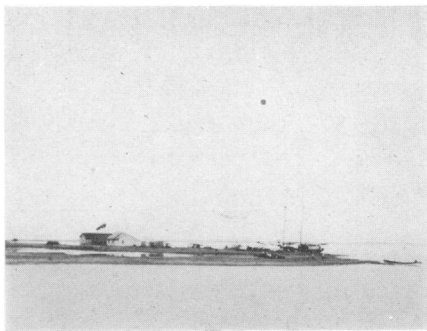


FIG. 14.



FIG. 15.

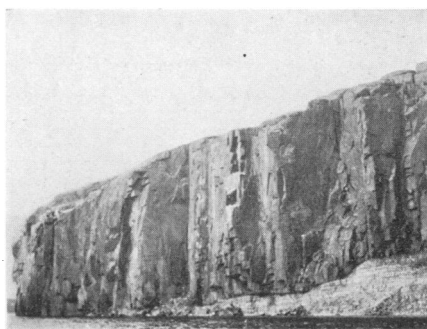


FIG. 16.

FIG. 11—Eskimo women cooking with heather on Barren Grounds in shelter of a caribou skin hung up for a windbreak. Feshing Lake, near Bernard Harbor, July 3, 1915. Fish are to be seen drying on poles laid across stones.

FIG. 12—Young man, Umingmuktogmiut, in hunting costume, with quiver on his back. Cape Barrow, May 21, 1916.

FIG. 13—Ice, boulders, gravel, and driftwood pushed up on tundra by heavy summer gale. Camden Bay, Alaska, east of Collinson Point, July 3, 1914.

FIG. 14—Cape Bathurst (Baillie Island), the most northerly trading post in Canada. July 26, 1916.

FIG. 15—Dolomite cliff, capped by diabase, Adligak Island, east of Barry Island, September 10, 1916.

FIG. 16—Cliff of diabase, overlying red quartzite, south side of Barry Island, Bathurst Inlet, September 6, 1915. There was a large glaucous gull rookery on this cliff.

snow blocks, descending twenty or thirty feet into a deep pit, and immediately ascending another ridge. It was much like working through very bad pressure-ridge sea ice. Frequently we had to boost and lift the sled up over ridges by main strength and take the dogs out of harness to let the sled down. The rock strata are horizontal in most places, with some slight local variations of not more than four or five degrees. Quartz geodes, with brown and transparent crystals of topaz, were numerous in the walls of the canyon. The tops of the surrounding hills are covered with small stones, little angular fragments of dolomite, and a few boulders of granite and diabase. The ground is barren. The only signs of life seen on the whole river trip were an Arctic fox track near Mount Davy, a few Arctic hare tracks, and one hare which we killed. One raven was seen near the mouth of the river. The coldest weather of the winter was recorded while we were up Croker River, 46° below zero Fahrenheit, at 6 A. M., March 31. The thermometer rose to 9° below zero at 4.30 P. M. the same day.

We climbed Mount Davy, the most conspicuous landmark of this whole region. Its top is about 2,000 feet above sea level, the mountain itself being only a hemispherical mound of gravel rising about 200 feet above the general level of the gradually rising coastal plain. The so-called range of mountains extending from the Melville Mountains south of Langton Bay and following the coast from Darnley Bay east seems to be entirely composed of this type of rugged drift-covered hills.

OLD BEACH TERRACES OF AMUNDSEN GULF AND DOLPHIN AND UNION STRAIT

The year before, on the east side of Darnley Bay, beach gravels and terraces were found above 500 feet, and everywhere east of that point the country for some distance from the coast is of the same type. The coast has a well-defined shore line of rock or boulders and gravel. West of Chantry Island (off Bernard Harbor) there are well-preserved beach terraces up to over 45 feet above high water, and numbers of fossil shells, similar to those on the present strand line, were collected at different levels. Near the mouth of Inman River numbers of shells were collected about 170 feet above the present sea level.

The coast line from Cape Lyon eastward was found to be somewhat straighter than the former charts give it, but this difference is due to the impossibility of sketching a coast line accurately from a boat passing some distance off shore. Many of the so-called points on the map of this coast are not salient projections. The named points are more often high land or rock cliffs with low land on either side of them, giving the higher places the appearance of points or capes when viewed from a distance. The method adopted by Mr. Chipman of locating control points at frequent intervals by latitude, longitude, and azimuth observations, and traversing between these points by frequent compass sights and pacing all of the intervening shore lines will undoubtedly give a more accurate map, although the

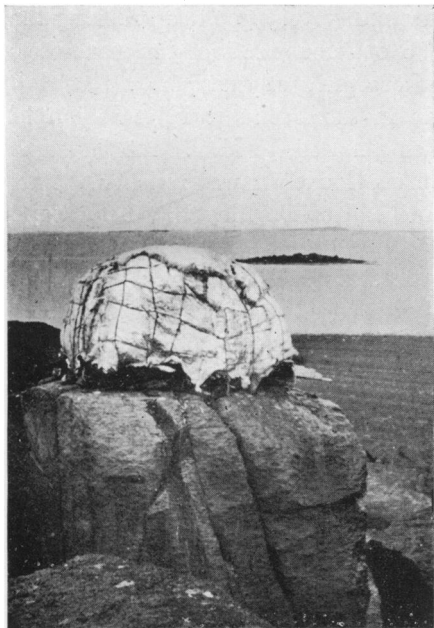


FIG. 17.



FIG. 18.



FIG. 19.



FIG. 20.

FIG. 17—Eskimo cache at Point Wollaston, Banks Peninsula, Bathurst Inlet. Placed on pinnacle rock to protect it from predatory animals. August 29, 1916.

FIG. 18—Young man, Umingmuktogmiut, at Cape Barrow, with quiver on his back. May 21, 1916.

FIG. 19—Pillar of diabase, Barry Island, Bathurst Inlet. September 7, 1916.

FIG. 20—J. R. Cox taking time-sights at Alaska-Yukon Boundary Monument (141st meridian), August 4, 1916.

former maps of this section of the coast are really very good considering the conditions under which they were made. No serious rectification was necessary until we came to Stapylton Bay and eastward of that point.

The survey parties began work again in the Bathurst Inlet region in March, 1916, and completed their work as planned, in May. At the same time the survey of the south coast of Coronation Gulf was finished. This completed a survey of the coast from the head of Darnley Bay near Cape Parry ($70^{\circ} 4' \text{ N.}$, $123^{\circ} 37' \text{ W.}$) to a point well up in Bathurst Inlet, including many adjacent islands, all on the scale of ten miles to the inch. About two hundred islands were carefully surveyed in the region originally roughly charted as Lewes, Marcet, and Chapman Islands in Bathurst Inlet. These islands are steep and rocky, and they overlap in such a manner as to appear continuous when viewed from a distance.

THE BATHURST INLET COPPER AREA⁹

The most important result of the geological investigations by O'Neill was the detailed mapping and estimation of the available copper-bearing rock in a great new area hitherto very slightly known in the Bathurst Inlet region. Copper-bearing rocks occur on most of the islands west of a line running northwest-southeast from Lewes Island and north of Kannuyuk (meaning Copper) Island. They cover most of Banks Peninsula (Tikera-yuk, the forefinger) and the western mainland shore from the mouth of Hood River to Moore Bay, extending as much as five or six miles inland from the coast. These rocks are amygdaloidal and form several successive layers which represent progressive, intermittent effusions of lava. Nearly all of these are impregnated over wide areas with native copper, occurring in veins and amygdules, and peppered through the ground mass. An estimate by O'Neill, of the copper-bearing rock, in which copper was actually seen, puts two billion tons well within the limit. As far as analyzed, the ore is of low grade, but further prospecting may locate veins and areas rich enough to render mining operations profitable. It is certainly a great reserve of copper ore. Galena was also observed, and other minerals doubtless occur. Isolated nuggets of float copper of considerable size were found; one in our collection weighed about forty pounds.

Some time in the future, possibly soon, these mineral areas will be utilized. They are remote at present and need transportation facilities, but are not much farther north than paying properties in Alaska, and in Norway, and are much farther south than the working mines of Spitzbergen. The climate is not too bad; there is a summer of about four months, and the snowfall is light in winter. Water transportation around Alaska would be rather long and uncertain, but, barring certain shoals on Bear River, there is good water transportation to the east end of Great Bear Lake, which

⁹ *Summary Rept. Geol. Survey of Canada for 1916, Ottawa, 1917.*

is not far from the Coppermine area. Bathurst Inlet is a little farther, but short railroad lines could be run without serious obstacles. The winter temperature on the coast averages considerably warmer than at most points in the interior.

ETHNOLOGICAL WORK OF THE EXPEDITION: THE COPPER ESKIMOS

The ethnologist of the expedition, Mr. D. Jenness, crossed with a band of Eskimos to Victoria Island in the middle of April, as they followed the migrating caribou, and spent the whole summer and autumn of 1915 wandering alone with them after caribou and fish. The journey was somewhat unpleasant, as much of the time they were without fuel for either cooking or heating, but his experiences are interesting and he obtained a good understanding of their language, habits, folklore, and viewpoints on life in general. During the winter he supplemented this with intensive studies of the village snow-house life, and made many gramophone records of songs, shamanistic performances, and the like. Mr. Jenness was not able to return to the station until November 9, 1915, when the ice became strong enough to cross Dolphin and Union Strait to the mainland.

There is a permanently uninhabited strip of coast 300 to 400 miles long, from Cape Bathurst, the easternmost village of the so-called Western Eskimo, to Cape Bexley, the western limit of the Copper Eskimos. I shall not go into detail in describing the Copper Eskimos, since an article on that subject by Jenness has already appeared in the August number of the *Review*.¹⁰

While hunting caribou for clothing-skins in late summer and early autumn, the Copper Eskimos live largely on their flesh and frequently dry a quantity of meat, but this dry meat seldom does more than tide them over until the ice sealing commences. In the pursuit of the caribou they often go far inland, to Dismal Lake, Dease River, and other places too far to bring food back, as all summer inland transportation must be by back-packing, by both people and dogs.

As soon as the sea ice is frozen hard and the snow packed well enough for house-building, usually in November or early in December, all move out on the ice, build snow houses, and live until spring almost exclusively on seals, which are caught by spearing at the seals' breathing holes. The seal's flesh is eaten, and a large part of the blubber is used in stone lamps primarily for cooking, and incidentally for warming the snow houses. In spring much blubber is stored in sealskin "pokes" for fall use. Even in winter meat is usually eaten cooked.

As the sun grows warmer, snow walls, roofed with skins, are used for shelter, and during the summer the people live in caribou-skin tents, some of which are little A-shaped structures, while others are large and constructed like an Indian lodge or tepee. In summer driftwood chips are burned on

¹⁰ *Geogr. Rev.*, Vol. 4, 1917, pp. 81-91.

the coast, while inland tiny shrubs, dwarf willow, dwarf birch, heather, or other woody plants are used, so that no difficulty is experienced in living on the Barren Grounds in that season. Fire is kindled by striking sparks from two lumps of iron pyrites, the use of flint and steel being apparently unknown. Rarely is fire produced by friction with a bow-drill.

After the seals come up on the ice in the spring—the harvest time for blubber among the Western Eskimos—the Copper Eskimos must quit sealing on the ice and come ashore. Early in the spring they fish extensively through the ice or along the shores of lakes, jigging with large hooks



FIG. 21—*Dryas octopetala*, a common Arctic flower, with white calyx and yellow center, on Arctic coast of Dolphin and Union Strait, at Bernard Harbor. July 3, 1916.

formerly crudely hammered out of native copper. At this season they also shoot or snare a good many Arctic ground squirrels (Parry's spermophile), making use of both the flesh and the skins. Rock ptarmigan are also killed in some numbers with bows and arrows. Later, when the fish begin to run up stream from the sea, or down stream from the lakes, the Eskimos spear salmon trout in the rapids, or impound them in stone weirs. The use of fish nets was unknown to them until about five years ago, and only a very few have yet obtained nets.

Fish are abundant almost everywhere. Large salmon trout or Dolly Varden trout run up the streams in great numbers, whitefish are numerous on the coast, big lake trout in almost every fresh-water lake of any size, while tomcod or frost-fish can be jigged in great numbers at certain spots.

Northern fish as a rule are of excellent quality, since fatness and firmness of flesh are characteristic.

Their improved methods of hunting large game with modern fire-arms will be only a very slight temporary advantage to the natives, as the law of diminishing returns soon begins to operate, and undoubtedly spells extinction for some species. The depletion of the musk ox is going on rapidly. It is already practically extinct west of Tree River. The rate of slaughter of caribou is likewise increasing. The desire of the natives for white man's goods is developing, and to trap furs to satisfy these demands the people must spend more time on land. Armed with rifles, they show a tendency to follow the line of least resistance and kill whatever game happens to be easiest to secure from day to day. Consequently a great many of the Copper Eskimos, who were normally seal-hunters from December until late in May, are now coming ashore one or two months earlier than was their former custom and living on the caribou which are migrating steadily northward at that season—mostly cows going north to rear their fawns on Victoria Island.

It is a difficult matter to do much for the protection of the musk ox, as the natives of these remote regions are practically beyond the jurisdiction of game laws and regulations. But although the savages are bound to kill a certain number on their own initiative and to supply their own necessities, they should not be encouraged and abetted in the slaughter by traders who have only a temporary interest in the country and will leave the natives to their own devices again as soon as the bulk of the fur-bearing animals have been destroyed. The same may be said for the caribou. With reasonable precautions immense herds can be conserved for future use. This would seem to be much easier and more economical than first exterminating the caribou and afterwards having to introduce reindeer to feed and clothe the natives, as was done in western Alaska. The reindeer, however, have a great field of usefulness where the caribou have been killed off.

CONCLUSION

The Southern Party of the Canadian Arctic Expedition entered upon the summer of 1916 with most of their originally outlined work completed. Many cases of specimens in all branches of science—geology, zoölogy, botany, ethnology, archeology—all had to be packed and compressed into one small 65-foot schooner. In addition to our specimens, the boat had to carry a stock of reserve provisions large enough to see us safely out of the Arctic, and it had to take twenty-seven people to Herschel Island, including our civilized Eskimo employes and two officers of the Royal North West Mounted Police who were taking two Eskimos out for homicide, the first advent of the law into the region east of Cape Bathurst.¹¹

¹¹ *Rept. of the North-West Mounted Police for 1916, Ottawa, 1917.*



FIG. 22.

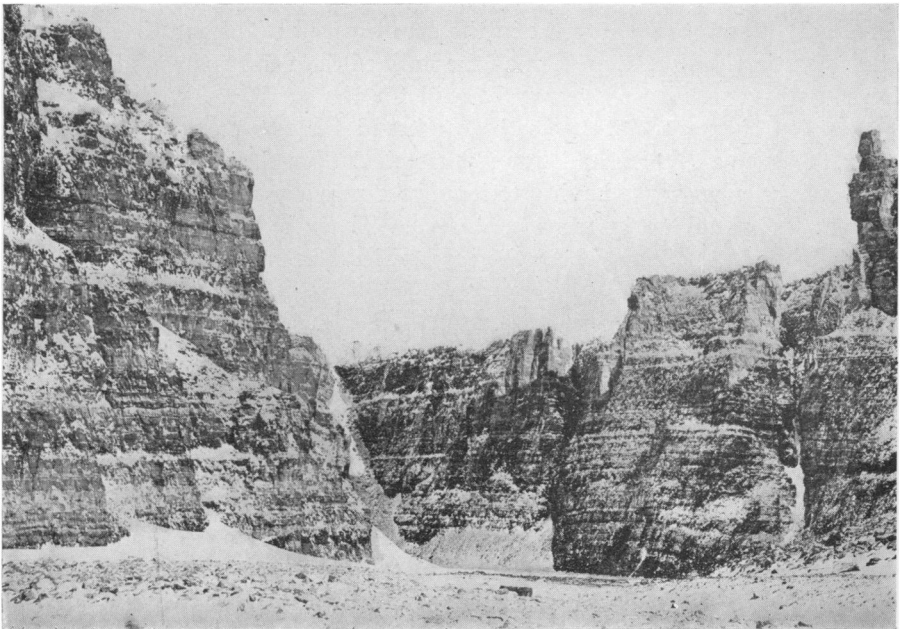


FIG. 23.

FIG. 22—Eskimo spring dwelling. After the sun begins to melt the roofs of snow houses, the Eskimos use caribou-skin roofs supported on poles, retaining the snow walls until some time later in the season. This house is higher inside than it appears to be, because the floor is excavated a foot or two into the snowbank. Bernard Harbor, April 20, 1916.

FIG. 23—Dolomite cliffs in canyon of Croker River, eight or ten miles from mouth of the river. March 18, 1916.

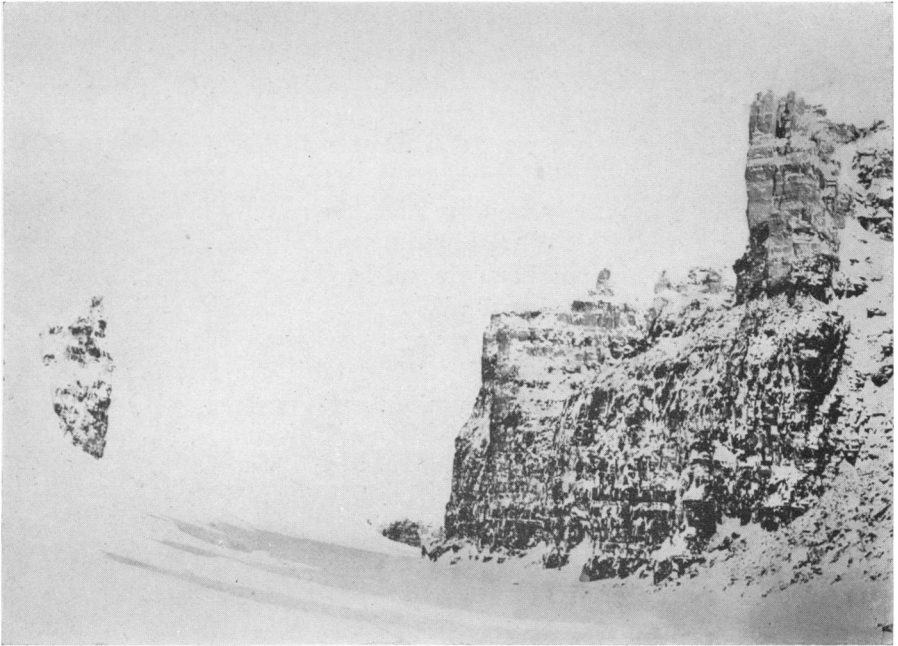


FIG. 24.



FIG. 25.

FIG. 24—Castellated dolomite cliffs in canyon of Croker River, six or eight miles from mouth of the river. Expedition sled barely discernible at foot of cliff. First exploration of this river, March 18, 1916.

FIG. 25—Rough ice on Coppermine River between Melville Creek and Muskox Rapid, March 31, 1915. Ice is jammed high up on the boulder banks on both sides of river and all the way across for miles.

We were well loaded down when we left Bernard Harbor on the evening of July 13, 1916. We made a quick and easy voyage out: Baillie Island, July 24; Herschel Island, July 28; Point Barrow, August 8; and Nome, August 15. Our weather-beaten schooner was left at Nome to be sold, while men and specimens went on to Seattle and Victoria through the famous Alaska and British Columbia Inside Passage. Everything ultimately reached Ottawa safely, and the scientific men of the expedition have spent the winter of 1916-1917 working up their reports. Maps have been computed and plotted, mineral analyses made, plants and animals are being identified and new species described. Some of the collections represent specimens of groups which have never been collected anywhere in the western Arctic area, and practically all of them are from districts and localities which are unrepresented in collections anywhere and from regions never before visited by a collector.